Options for future governance in research and innovation

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The digital transformation of research

- The importance of the new global communication opportunities on the one hand, and of digital access on the other for traditional science and technology activities of researchers world-wide cannot be easily overestimated.
- To put those in perspective, let me start by quoting the historical parable from Paul David and Dominique Foray ten years ago:

Rachid and…

- *“Let us compare the experiences of two scholars: Rachid, a seventeenth century astronomer from the beautiful town of Fez, and Rachel, an imaginary young engineering postdoctoral student working in a Stanford University laboratory in the late twentieth century. Rachid invented a new telescope and wanted to transmit the details of his discovery to colleagues in Cordoba, Padua and Salamanca. This was an arduous task because this kind of knowledge had not yet been codified at the time and he had to copy all of his plans and notes by hand. Rachid then entrusted his precious documents to the northbound caravans, in the hope that they would one day be delivered to his colleagues. There was little certainty of that happening. More problematic still are the situations in which knowledge is basically memorized and passed on by word of mouth (accompanied by somewhat incomplete papers intended to assist recall), because the circle of effective users typically remains confined to direct, personal contacts. Moreover, as that circle is widened, there is an increasing risk of the content becoming distorted in the course of oral transmission and successive copying. Only recurring communications back-and-forth among each of the pairs participating in such a network of transmission would operate to limit the propagation of "copying errors". The likelihood of that occurring, however, diminishes as the number of links in the human chain of communications increases. Hence, there are physical limitations preventing expansion of the community of people who can harness new knowledge, and possibly further improve upon Rachid's design. Knowledge flows have existed throughout history, but, as a rule, they have been few and far between and relatively feeble….*

Rachel

- *As for Rachel, let us say that she invented a small robot, working out the engineering details with the help of a computer-aided-design (CAD) program. Wishing to inform her community, she quickly produced the relevant documents and plans with the help of graphic design software. The files were then copied and dispatched as email attachments to a list of selected addresses. Within seconds, they were received by dozens of laboratories throughout the world and hundreds of researchers could begin reproducing the knowledge and sending back their comments, criticisms and suggestions. Knowledge codification and transmission costs here were very low (i.e. Rachel's marginal costs of codifying and transmitting the knowledge in question, given the fixed infrastructure, and her training costs). So too were those of its reproduction. Indeed, this is the case when the invention itself remains within the framework of knowledge with which the community's members are familiar: the people receiving the file have "learned to learn" this kind of knowledge and the attached document provides a detailed learning programme."* (David and Foray, 2002, p.6-7).

The issue

- Ultimately the digital or e-impact on science and research activities, allowing for an increased speed and capacity for data analysis; for global distributed access to huge amounts of data and for the use of digital platforms for research collaboration and communication has opened up many new fields to scientific research, technological breakthrough and to successful innovation… the only sustainable long term productivity impact of so-called “new” growth theory:
- As in the case of the new economy though, it would require a re-organisation of research and scientific activities, new forms of collaboration in research, increased open access to codified data in data bases and computer models, simulations and visualisations…
- Again a quote from Paul David: *“Engineering breakthroughs alone will not be enough to achieve the outcomes envisaged for these undertakings. Success in realizing the potential of e-science – and other global collaborative activities supported by the ‘cyberinfrastructure’ – if it is to be achieved, will more likely be the resultant of a nexus of interrelated social, legal and technical transformations.”*

Research challenges

- Research is itself confronted with a number of major challenges in new areas such as climate change, human cognition, cells, the elementary structure of matter, language, social networks. Characteristically these areas are:
  - *Fundamentally complex;*
  - *Available data are always "scarce";*
  - *Further knowledge development involves the building up extremely large data sets;*
  - *Knowledge development requires inter-disciplinarity.*
- Recent report on Science 2.0 for the EC by Osimo and Szkuta highlights a "scaling up" of serendipidity effect on e.g. disruptive innovation.
- The development of *machine learning* and *data mining software* is now so developed dat the analysis of large data sets is not just particularly useful and relevant for researchers but also for "innovators"). A run of a data algoritm can deliver a paper in *Nature*, it can also form the basis of a new company.

Science 2.0 policy challenges

- Organisational challenges associated with open research, but also in business (business 2.0 models? pilots within the scientific publication sector?) and within broader institutional settings (academia and PROs);
- Policy challenges: what is the European Science 2.0 dimension? Science 2.0 is global, hence also a challenge to the concept of ERA…
- Not all research data is the same: interoperability of data is hampered by different “quality notions” of data across disciplines;
- Crowd-funding as the new social capital in support of collective intelligence, and as alternative to global public funding increasingly under pressure because of national fiscal austerity.
- Data access leads to many information paradoxes (Hirschleifer e.g. on decision stalemates as more data becomes available). The ultimate paradox: Science 2.0 seems to be accompanied with less trust in data and research. Science finally throughly democratic?

Options for future governance

- Health to some extent the easiest to get international science cooperation organized. Role of UN and WHO undisputed. Area also with the strongest appeal to citizens across the world.
- Natural disasters broadly similar. Interesting here also the possibilities for global insurance markets. Failure though of those emerging (Drèze) beyond commerical international exchanges. UNESCO also absent here…
- Could health and its success stories be enlarged to include e.g. the health of our oceans (including fishing) and other global “public goods”?
- Most difficult when research and innovation become part of an economic competitiveness and/or a political independence logic: in areas such as food and nutrition or alternative energy sources. National competitiveness and/or independence arguments ignore global systemic linkages.
- Most needed probably in the area of climate change: extremely complex science with large uncertainties, massive data scarcity, requiring multitude of disciplines. An ideal topic for the international science community; yet today probably the area with the highest frustration amongst scientists and researchers.